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INSECTS IN FARM-STORED GRAIN

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INSECTS IN FARM-STORED GRAIN

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Warfare against destructive insects is not ended when grain has been harvested and placed in storage. In the granary, it is subject to attack by stored-grain pests that reduce the value of cereals for seeding, feeding and marketing.

It is noteworthy that surveys by the Canadian Grain Commission shows that stored grains in country elevators and on farms in southwestern Ontario have the heaviest insect infestations of any region in Canada. Ontario grain growers sustain considerable loss annually. These losses are indicated by the kinds of damage that can occur.

DAMAGE CAUSED BY INSECTS

1. **Loss in Grain Weight (Shrinkage).** Insects feeding on grain consume varying amounts of it, thereby reducing the weight. Adults may devour their own weight of food each week while their larvae will consume many times their own weight during their developmental period.

2. **Loss in Food Value.** When either or both the germ and endosperm of a kernel are destroyed, the value of grain is greatly reduced. They are important nutritive constituents in milled grain for human food or animal feed.

3. **Low Seed Germination.** The destruction of the germ reduces or completely destroys the viability of grain used as seed. Damaged grain has to be sown in greater quantity to make allowance for some of the kernels that will not germinate. If the endosperm alone is damaged the seedling will often not come up because it lacks sufficient food to develop, although the germ is sound. The viability of seeds is also reduced or destroyed by heating and high moisture which can be caused by insects infesting stored grain.

EXAMPLES OF INSECT DAMAGE

Photos courtesy Kansas State University

(a) Indian meal moth larvae injury to corn

(b) Barley germ destroyed by the larva and adult of the saw-toothed grain beetle

(c) Wheat kernel opened to reveal presence of granary weevil larva

(d) Granary weevil emergence holes in wheat kernels

4. **Heating and Spoilage.** Insects clustered together in grain bins create through their metabolism excess heat and moisture which are absorbed by the surrounding grain to form "hot spots". When warm, moist air rises from the heated area to the cool surface, condensation occurs. Molds and fungi develop, thereby causing the surface grain to cake and spoil. A musty odor is also imparted to the grain. This type of damage may be greater than destruction by feeding.

5. **Contamination.** Adulteration of wheat, corn and other cereal grains, due to the presence of insects in or outside the kernel, their excrement, molted skins, disintegrated carcasses, webbing and obnoxious odors, seriously impairs the grain for milling purposes. Only a portion of this filth can be removed in the cleaning operation.

6. **Reduction in Market Value.** All of the above reduce the value of the grain through a lower grade or when sold for feed or seed.

7. **Destruction to Wooden Granaries.** The cadelle larvae tunnel into wooden structures and in time weaken them to a point necessitating repairs.

HOW GRAIN BECOMES INFESTED

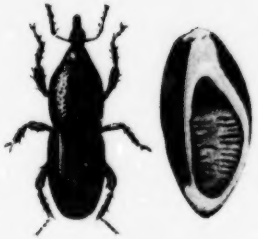
Because insects in stored grain are relatively small and difficult to detect, it was thought at one time that they generated spontaneously in the grain. However, their origin is well known and the following constitute the common sources of infestation.

1. (a) **Wooden Bins.** Grain accumulations in cracks, crevices, in double walls, outside and under the structure.
   (b) **Steel Bins.** Grain accumulations associated with augering and aeration equipment and about the foundation.

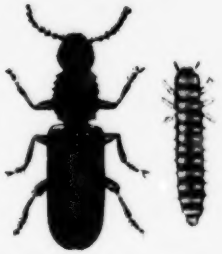
2. **Bins of Old Grain.** Insects in old grain move directly into newly binned grain dumped on top of the old.

3. **Feed Rooms and Feed Bins.** The insects which attack stored grain are often present in feed rooms and bins of livestock feed and can move quite readily to newly stored grain if binned nearby.

INSECTS INJURIOUS TO FARM - STORED GRAIN IN ONTARIO



1. Granary weevil



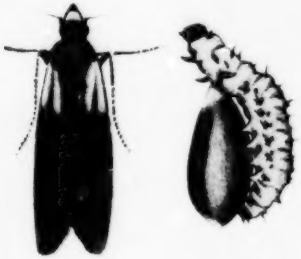
2. Saw-toothed grain beetle

3. Flour beetles

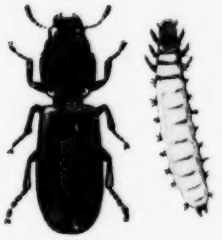
4. Mediterranean flour moth

5. Yellow meal worm

6. Hairy fungus beetle



7. Indian meal moth



8. Cadelle

9. Rusty grain beetle

10. Spider beetle

11. Grain mite

INSECT	DESTRUCTIVE STAGE	FEEDING HABITS AND DAMAGE	DESCRIPTION
1. Granary Weevil	Adult Larva	Chews outside of kernel Feeds in interior of kernel	Dark brown snout beetle, 4 mm long Whitish, 4 mm long worm
2. Saw-toothed Grain Beetle	Adult Larva	Both feed on germ, grain dust and broken kernels	2.5 mm long, dark red, saw-toothed points on plate behind head 4 mm long, brown head, 6 legs, builds protective cover from bits of food
3. Flour Beetles Red Confused	Adult Larva	Both feed on whole kernel if moisture is 12% or greater, otherwise are ground cereal feeders	Reddish-brown beetle, 4 mm long Brownish-white, 6 legs, 4 mm long Red species flies at 25°C.
4. Mediterranean Flour Moth	Larva	Prefers ground cereals	Pinkish-white, 15 mm long, feeds in protective webbing Adult moth is gray, 6 to 12 mm long, zigzag lines on fore wings
5. Meal Worm	Larva	Feeds on cereals out of condition	Resembles wireworm — yellowish, smooth, shiny-bodied, 25 mm full grown Adult — large black beetle
6. Hairy Fungus Beetle	Not important destructively	Scavenger on decaying corn, on surface of out-of-condition small grains	Adult — tiny, brown, hairy
7. Indian Meal Moth	Larva	Feeds within webbing spun around several kernels	White to pink with brown head, 8 to 12 mm long Adult — has wing spread of 12 to 18 mm, base of wings gray while tip half, head and thorax are reddish-brown (flies from infested grain or old sacks)
8. Cadelle	Adult Larva	Especially destructive to germ Especially destructive to germ, also bores holes in wood, cuts holes in sacks	Black beetle 8 to 12 mm long Grayish with black head and black spots on some body segments, 18 mm when full-grown
9. Rusty Grain Beetle	Adult Larva	Feeds on broken kernels Feeds on germ under germ coat	Reddish-brown, 2 mm long Flies at 25°C.
10. Spider Beetle (found occasionally in granary)	Larva	Feeds on kernels, but are seldom numerous enough to cause extensive injury	Beetle is dark brown with spiderlike legs, 4 mm long
11. Grain Mite (not insect)	Adult	Feeds on germ, grain dust and dockage	Very tiny, difficult to detect without magnification

4. **Adjacent Bins of Infested Grain.** Often grain is placed in a bin next to one that is infested.

5. **Seed and Feed Purchases.** Seed grain, screenings, poultry feed may be brought to the farm in an infested condition.

6. **Accumulations of Waste Grain and Feed.** Spillage, seepage through cracks, grain trapped within double-walled structures, self-feeders, grinders, and piles of used uncleaned grain, and feed sacks are all potential insect sources.

FACTORS AFFECTING INSECT ABUNDANCE

Where grain-infesting insects gain a foothold their abundance is determined not only by the availability of suitable food, but also by their temperature and moisture requirements. These are within a specific and limited range. The most favorable moisture range is between 11.5 and 14.5% while the temperature range is between 21 and 30°C. Levels above or below the minimum and maximum of these ranges are not conducive to reproduction of most species.

DETECTION OF INFESTATIONS

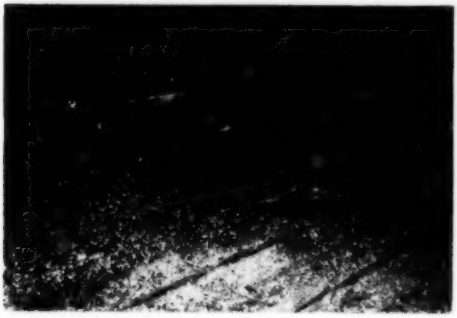
Due to the rapidity with which an insect infestation can build up, it is recommended that grain be inspected every two weeks for signs of infestation, especially during the warmer months of the year. Heating caused by insect activity may be detected by looking for damp or crusted areas on the surface of the grain, by thrusting a hand into the grain, and by checking for abnormal odor. The presence of moist and heated grain a few feet below the surface may be determined by probing with a metal rod or pipe of small diameter. Tough grain is indicated when the rod will not pass through it as readily as grain in the other parts of the bin. Heating is also indicated if the rod is warm when it is withdrawn.

To check for insects on the surface of the grain, screen with a 10-mesh sieve. A special probe is required for deep sampling.

SOME SOURCES OF INSECT INFESTATIONS

Photos courtesy of Kansas State University

(a) Accumulation of grain and chaff around and under feed grinder



(b) Unswept bin floors and corners

(c) Feed room littered with feed and empty feed bags

(d) Feed accumulation behind a manger near grain storage bins

HOW TO PREVENT AND CONTROL INSECT INFESTATIONS

Grain may be kept free of damaging infestations by employing good management practices. These include sanitation, use of residual sprays, proper storage of grain, and if necessary the application of grain protectants and fumigants.

1. **Store Grain in Clean Bins.** Before placing grain in storage, thoroughly clean out the bin. Never add new grain on top of old grain. Remove accumulations from corners, cracks and crevices, behind partitions, between double walls, outside and under bins. These sweepings should be burned or buried, and not placed where insects may return to infest newly binned grain.

2. **Separate Grain Bins from Feed Storage.** Feed bins and feed rooms, especially those with grinding equipment, are difficult to keep clean. Insects will readily migrate to market grain binned nearby.

3. **Avoid Storing Grain in Hay or Livestock Housing.** Heat given off by animals and the insulation provided by hay next to or over grain bins will prevent the seasonal cooling of the grain, thereby allowing insects to remain active throughout the winter. In addition, mangers, feed boxes or troughs are frequently infested, thus providing a continuing source of infestation.

4. **Maintain Storage Facilities in a Grain-Tight Condition.** Granaries in a good state of repair minimize the number of harboring sites where insect populations can exist. These structures should also exclude rodents, birds, poultry as well as rain, snow, and soil moisture.

Residual Bin Sprays

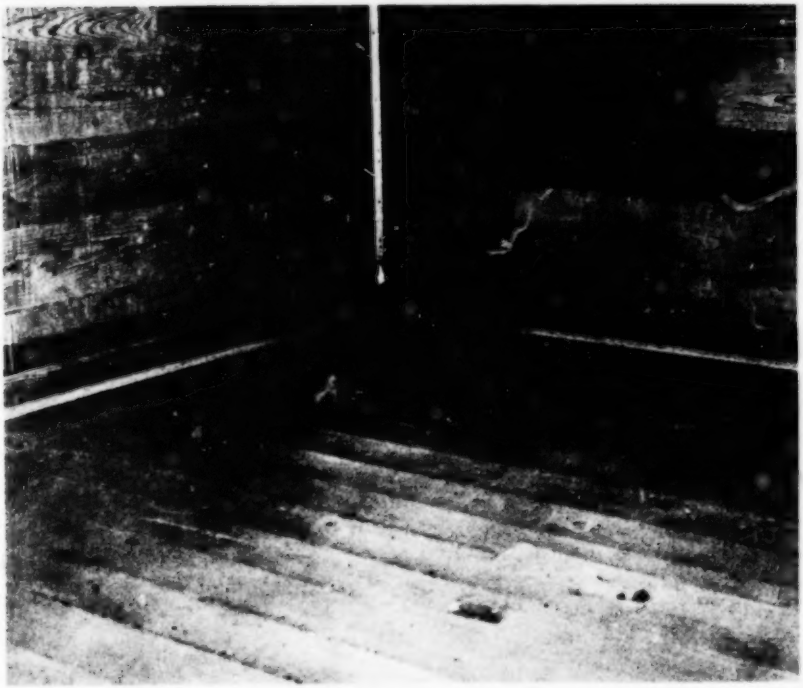
After granaries and bins have been prepared for the reception of new grain, an added precaution is recommended. Spray the floor, walls and ceiling with an insecticide that will kill insects that remain in or migrate to the empty bin. To obtain the maximum effect apply at least two weeks prior to storage.

Use a bin spray containing **MALATHION** at the rates recommended on the product label.

Apply with a compressed air lawn-type sprayer to the point of runoff. 5L of finished spray will treat 100m^2 of bin surface. Wet all cracks thoroughly.

Storage of Grain

Storage of clean grain inhibits insect activity. Grain that is free from broken kernels, grain dust, and foreign material is less likely to become infested with insects. The largest proportion of stored-grain insects feed on and breed rapidly in dockage. Their activities produce heat and moisture that put the sound grain in bad condition.



A tight, clean, sprayed bin ready for storage

Grain stored dry and kept cool is seldom infested. Reproduction of grain-infesting insects begins when the moisture content of grain is 11% and the temperature 18 to 21°C. Accordingly, it is desirable to harvest grain at a moisture as close to 11% as possible. In unsheltered bins adequate ventilation will provide sufficient air drainage to lower the temperature for safe storage.

Grain Protectant

A grain protectant should not be regarded as a "cure-all". Its function is to prevent an insect infestation from developing and not to eradicate one that is already established. A known infestation should be fumigated before a protectant is used.

Where insect infestations are likely to develop, or where tough grain has been harvested, **malathion** (special deodorized grain formulation only) may be applied as a dust or a spray as the grain is placed in storage. Use at the rates indicated on the label. These may vary with the product selected and the grain treated. Caution: Do Not Feed or Sell Grain for Seven (7) Days after Treatment.

It should be noted that depending on grain moisture and temperature malathion can degrade rapidly. At 21°C and 14% moisture malathion is effective for 6-12 months; at 15% for 2 months; at 16% for only 1 month.

Grain Dryer High Temperature Effect

A temperature of 60°C for ten (10) minutes is fatal to all grain infesting insects. Although grain dryers are operated at temperatures up to 80°C, total insect control is not guaranteed. The grain can shelter the insects to some extent thereby reducing the required exposure necessary to kill them. Moreover, any insects within kernels would live. This method may provide false security.

Fumigation

A fumigant can be used as a last resort when other means of control have failed. When applied it vaporizes to a gas heavier than air that penetrates the grain bulk.

Certain requirements must be met if satisfactory results with a fumigant is to be obtained. It is necessary to make the bin as gas-tight as possible, level the surface of the grain to insure uniform penetration, and to apply the fumigant at the recommended temperature when the wind is very low.

Aluminum Phosphide (Phostoxin, Gastoxin, Detia Gas) is currently the only farm grain fumigant available for use in Ontario. It is produced as a pellet or a tablet. The pellets or tablets are probed in or at least heeled in at 1.2 metre intervals across the surface of the grain. A plastic sheet placed on the surface of the grain helps prevent escape of the gas. The number required depends on the type of storage facility, and the volume and temperature of the grain to be fumigated. The temperature also determines the required number of days of exposure to insects for effective control. For example:

Dosage per 100 cubic metres of Grain				
Storage	**Grain temperature °C**	**Tablets or Pellets**		**Required exposure time**
Steel	12–15°C	500	825	5 days
Steel	16–20°C	500	825	4 days
Steel	Above 20°C	500	825	3 days

Note *Fumigants containing aluminum phosphide must be applied by licensed fumigators in Ontario.*

Precautions When handling fumigants, follow all safety directions given on the manufactured product. Always work in pairs. Wear the recommended gas mask. Remove livestock or poultry that are in the same building, especially if they are under the grain bin.

HEALTH HAZARDS OF HANDLING STORED GRAIN

An illness commonly known as "farmer's lung" can result from handling grain in storage. It is caused by the inhalation of dust particles and mold spores that develop as grain goes out of condition. Lung tissue is damaged by these foreign substances.

People vary in their sensitivity, thus sickness may not occur until a few hours after handling grain. The first signs of discomfort are fever and breathing difficulties. The person usually feels better in a few days following the first exposure. However, repeated exposure increases one's reaction causing longer periods of illness that could result in lengthy hospitalization. The danger is permanent lung damage; the condition is preventable but not curable.

Prevention consists of wearing a proper dust mask. A handkerchief is not adequate. Keep exposure time to a minimum.